

Performance Evaluation of Improved Sweet Potato (*Ipomoea batatas L.*) Varieties at Gedeo Zone, Southern Ethiopia

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Abstract: Filed experiments were conducted during 2013/14 at Chichu and Dilla sites in Southern Ethiopia. The objective of the experiments was to determine and evaluate the growth, yield and quality performance of sweet potato varieties under Dilla and Chichu condition. Treatments comprised of five different varieties namely Pinno, Gadissa, Algetta, Gassa, and local variety. The experiment was laid out in randomized complete block design with three replications. The performance evaluation of different varieties was assessed by analyzing data on vegetative growth, yield and starch content. Results demonstrated that there is significant difference on performance of different sweet potato varieties on vine length, root diameter, yield, root weight, and starch content. Some varieties which had farmer desirable traits like high yield and high starch content were identified for both sites. In this study, the highest yield and quality was achieved by variety Gaddissa. However, in Chichu site variety Gassa was also results comparatively high yield. Similar to Dilla site, in Chichu also high starch content was reported from variety Gaddissa. Climate and soil conditions probably played an important role in variety performances.

Keywords: crop varieties, sweet potato, starch, root crops

1. Introduction

Sweet potato is among the most important food crops after wheat, rice, maize, Irish potato, and barley and ranks third after Irish potato and cassava in consumption in several parts of tropical Africa (Lenne, 1991). It is tolerant to cold than other tropical root and tuber crops and therefore can be grown at altitudes as high as 2500 m above sea level. In Ethiopia, sweet potato has been cultivated for many years and is an important in diet where population growth is highest, land holding is least and threat of large-scale starvation is ever present (Habtu, 1995).

The crop gifted with high potential to tolerate adverse environmental conditions such as drought, low soil fertility, high rainfall and it requires very little labor and care compared to other crops. It is used as a source of food and income to the poor and needy farmers in sweet potato growing areas. In addition, the different parts are used for various purposes: the root for home consumption and sale, the aboveground part for planting material, sale and feed for livestock, and as a soil conservation mechanism (CACC, 2003). It is also high in carbohydrate and vitamin A and can produce more edible energy per hectare per day than wheat, rice, or cassava. It has an abundance of uses ranging from consumption of the roots or leaves to processing into animal feed, starch, candy, flour and alcohol (Belehu, 2003).

Sweet potato is cultivated in over 100 developing countries and ranks among the five most important food crops in over 50 countries. Only in the last decade has the crop been the focus of an intense, coordinated, global effort to realize its full potential as a source of food, feed, processed products, and income for millions of small farmers and low-income consumers in Africa, Asia, and Latin America (Yanggen and Nagujja, 2006)

In Ethiopia, sweet potato is one of the major traditional and attractive food crops among farmers due to its high productivity, universal uses, high caloric content and good taste (Endale et al., 1994). In Southern Nations, Nationalities and Peoples' Region of Ethiopia, sweet potato is an important food security crop and it is a staple or co-staple food for the majority of the people in the region. In area coverage and production, it is the second important root crop next to enset in this region (Million, 2002). The report of Bureau of Agriculture of Gedeo zone indicated that the yield under farmers' management ranges between 6.5 and 9.0 tha-1 which is far below the potential yield.

The potential yield of sweet potato in research goes up to 50 t/ha but on station and on-farm research with improved management practices, it can give tuberous root yields ranging from 17.5 to 30.5 t/ha (Tenaw et al, 2001). However, because of various production constraints and poor management practices, the yield under farmers' condition is low. One of the reasons for low productivity is the use of low yielding cultivar. Therefore, the objective of the present study was to evaluate the growth, yield and quality performance of sweet potato varieties at Gedeo Zone, Southern Ethiopia.

2. Material and Methods

Treatments and Experimental Designs: the experiment laid out in randomized complete block design with three replications. Plant density was arranged by varying row the spacing between plants and rows is, 30x 70cm respectively and the plot size was be 1.5 m wide and 4m long.

Experimental Procedure: Four improved different sweet potato varieties were obtained from South Agricultural Research Institute of Areka Agricultural Research Center. DAP fertilizer was applied at the rate of 18 N and 46 kg P₂O₅

ha-1, and all the necessary agronomic/cultural practices was done where necessary and as the crop requirement in uniform manner. Improved varieties used for the experiment were Gadissa, Gassa, Pinno and Algetta. As a control and for comparison purpose local variety was taken as one of the treatments.

Data collection: At harvest, data on vine length, root length and weight, total biomass, and yield were recorded.

Soil and starch content analysis: soil Chemical and physical properties of experimental sites were performed before planting and the result is presented in table 1. Starch analysis was performed as indicated in Australian Pesticides Veterinary Medicines Authority (APVM, 2004)

Table 1: Soil Chemical and physical properties of experimental sites

Soil properties	Values	
	Dilla Site	Chichu site
pH (water 1:1)	8.45	7.87
CEC (c mol(+)/kg	42.26	38.33
Organic matter (%)	3.43	2.13
Organic carbon (%)	1.88	0.97
Total nitrogen (%)	0.19	0.123
Available phosphorus (ppm)	18.45	15.4
Sand (%)	18.67	20.23
Silt (%)	42.49	31.34
Clay (%)	37.96	23.9

Data analysis: The collected data was subjected to analysis of variance (ANOVA) following the statistical analysis system (SPSS software) and the difference between means were determined using least significant difference (LSD 5%) probability level.

3. Result and Discussion

3.1. Yield

Yield of sweet potato was significantly ($p < 0.05$) and high significantly ($p < 0.01$) affected by variety in Dilla site and Chichu site, respectively (Table 2).

Table 2: Analysis of Variance over sites for yield and quality

Source of Variation	Yield		Quality	
	S1	S2	S1	S2
Variety (V)	134.6*	34.8**	0.04*	0.05*
Error	14.8	6.76	0.003	0.006

S1: Dilla site S2: Chichu site

Yield was also significantly affected by the interaction effects of site and variety as shown below (Table 3). Similar results were reported by Amare et al (2014) for sweet potato.

Table 3: Mean square for yield and vine length

Source of variation	Mean Square		
	Yield	Quality	Vine length
Site (S)	1598.7	0.54	600.5
Variety (V)	74.5*	0.75**	15.4*
SXV	94.8*	0.14ns	15.3*

In Dilla Site, the highest yield was recorded in variety Gaddissa, which showed more than 50% increase over the local variety. However, in Chichu site, Gaddissa showed similar effect as that of the local variety. In Chichu site, the highest result was achieved by Gassa. But, in this site, both Algetta and Pinno were statistically similar with variety Gassa. Comparatively, in both site, Algetta and Pinno seems the second high yield varieties (Fig. 1).

Previous results showed that sweet potato yield varied among genotypes (Osiru et al, 2009). The variation in yield among locations may be attributed to weather or climatic factors, and the duration of growing periods (Mwololo et al, 2012; Osiru et al., 2009).

The main effects of environment were highly significant and contributed higher variation than the genotype to the total variation in yield, implying that the differential genotypic responses to environments were related to location differences in terms of factors such as soil type and soil moisture conditions during the four growing seasons (Moussa et al., 2011; Niringiye et al, 2014; Caliskan et al. (2007); Caliskan et al, 2007).

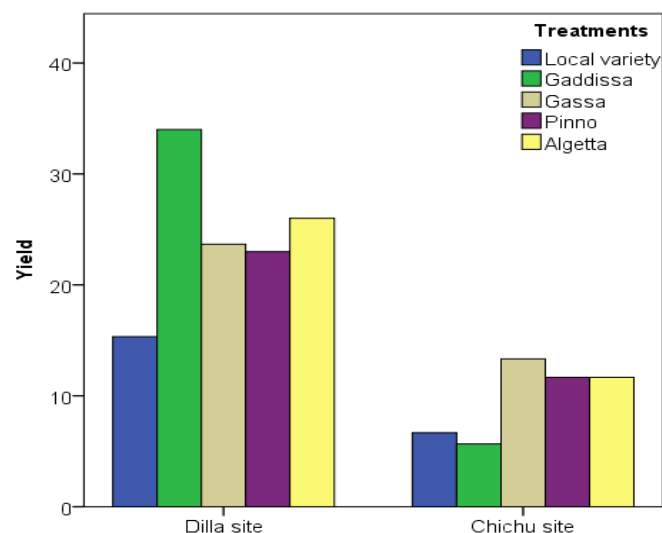


Figure 1: Mean yield of sweet potato in Dilla and Chichu sites

3.2. Vine Length

Similar to yield, vine length was significantly affected by the interaction effects of site and variety (Table 3). In addition, similar to yield, vine length was also significantly ($p < 0.05$) and high significantly ($p < 0.01$) affected by variety in Dilla site and Chichu site, respectively (Table 4).

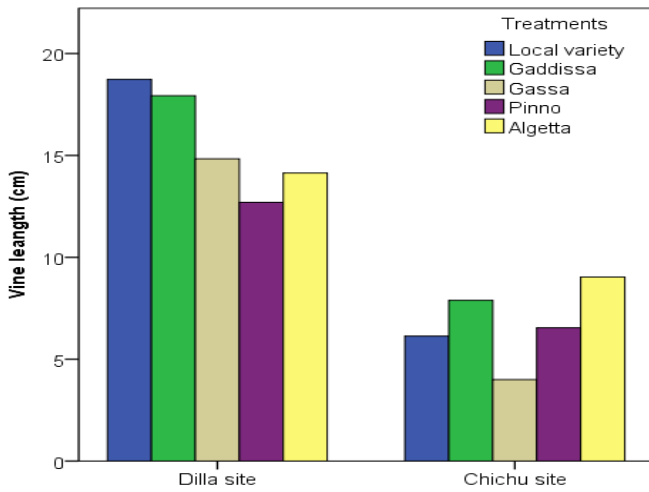


Figure 2: Vine length of sweet potato in Dilla and Chichu sites

In Dilla Site, the longest length vine was recorded in local variety, which is statistically similar with Gaddissa and Gassa. In the other hand, the shortest length was recorded from Pinno.

Table 4: Analysis of Variance over sites for growth parameters

Source of Variation	Vine length		Root length		Root diameter		Total biomass	
	S1	S2	S1	S2	S1	S2	S1	S2
Variety (V)	19.8*	10.9**	0.05ns	0.19ns	0.004**	0.017**	7.6*	0.57*
Error	4.06	1.08	0.08	0.15	0.001	0.002	1.6	0.09

However, in Chichu site, the longest was recorded from Algetta, which is statistically similar with Gaddissa and the shortest was recorded from Gassa (fig 2). Similar results were reported by Egbe et al (2012)

3.3. Starch content

The quality aspect of the sweet potato is determined by starch content. The result showed that starch content was significantly affected by the interaction effect of site and variety (Table 3). In both site, starch content was significantly ($p < 0.05$) affected by variety (Table 2).

In both sites, the highest starch content was recorded from Gaddissa, which statistically similar with Pinno. In both site, the least starch content was recorded from Gassa. However, in Chichu site, the starch content of Gassa is not significantly different ($p < 0.05$) with the local variety and Algetta (Fig.3).

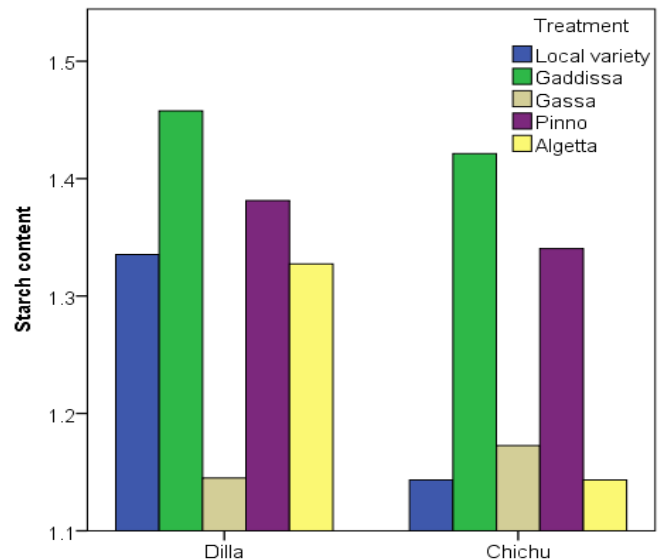


Figure 3: Starch content of sweet potato in Dilla and Chichu sites

3.4. Root length and Root Diameter

Root length and root diameter and root weight were not significantly affected by the interaction effects of site and variety. Root diameter was high significantly ($p < 0.01$) affected by variety. However, in both sites, root length was not affected by variety (Table 4).

The highest root diameters were recorded from Gassa, Algetta and local variety with no significant difference ($p < 0.05$). The least results were recorded from Pinno and Gaddissa (Fig 4).

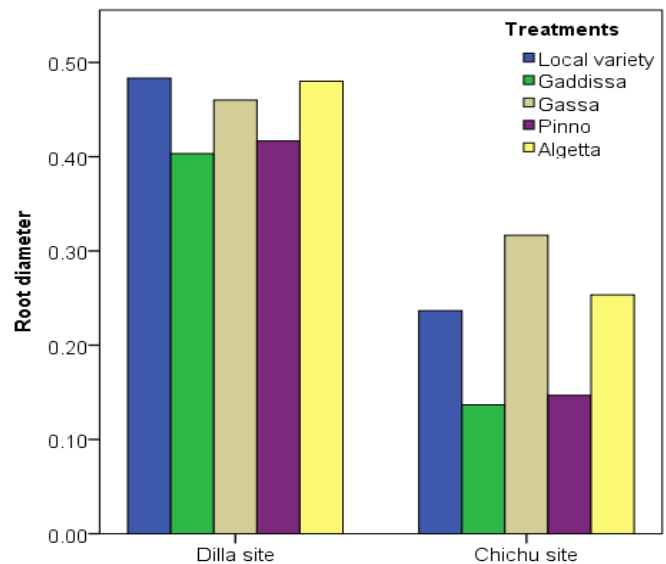


Figure 4: Root diameter of sweet potato in Dilla and Chichu sites

3.5. Total Biomass

In both Dilla and Chichu sites total biomass was significantly ($p < 0.05$) affected by variety. However, it was not significantly affected by the interaction effects of site and variety (Table 4). The highest biomass were recorded from

Algetta and local variety with no significant difference ($p < 0.05$). The least results were recorded from Pinno and Gaddissa (Fig 5).

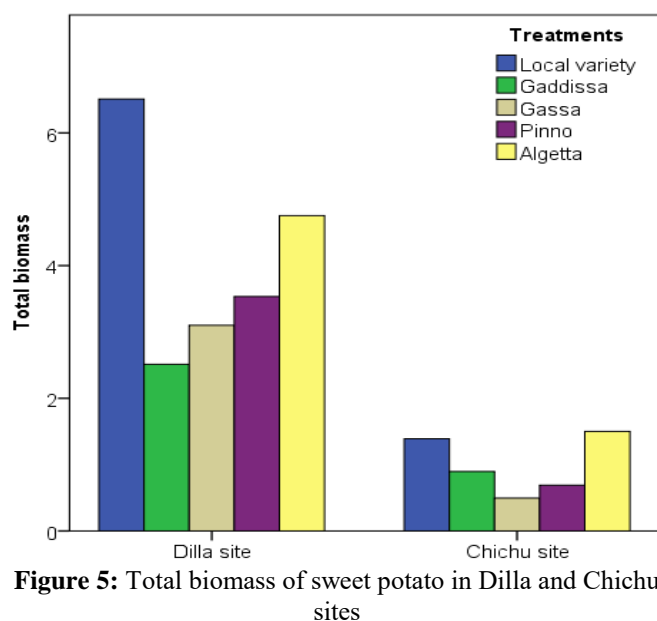


Figure 5: Total biomass of sweet potato in Dilla and Chichu sites

4. Conclusion

Some varieties which had farmer desirable traits like high yield and high starch content were identified for both sites. In this study, the highest yield and quality was achieved by variety Gaddissa. However, in Chichu site variety Gassa also results high yield. Similar to Dilla site, in Chichu also high starch content was reported from variety Gaddissa. Climate and soil conditions probably played an important role in variety performance. As a result, the performance of varieties must be further checked with the consideration of agronomic activities such as fertilization.

5. Acknowledgement

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